Roller cutter.

Background of the invention

The present invention relates to a roller cutter for a drill head for rotary boring of a front of earth and rock formations according to the preamble of the independent claim.

A roller cutter for a known drill head is kept in a saddle via a shaft of the roller cutter, see for instance US-A-4,428,271. In US-A-5,984,024 a roller cutter is shown provided with covers that hold sealing members in place in order to prevent grease from leaking out from the interior of the roller cutter. It is known to fasten the covers to the shaft in various ways, the known solutions meaning either complicated constructions or constructions that reduce the strength of the shaft.

Objects of the invention

One object of the present invention is to provide a roller cutter, the design of which contributes to longer operating periods.

Another object of the present invention is to provide a durable roller cutter.

Still another object of the present invention is to provide a roller cutter, the shaft of which does not crack so easy at load.

Still another object of the present invention is to provide a roller cutter, the cover of which is simple to fix.

Brief description of the figures

These and objects have been attained by a roller cutter according to the present invention having the features defined in the subsequent claims. The invention will be described more closely in the following, reference being made to the appended drawings.

In the drawings, Fig. 1 shows an axial cross-section through a raise-boring head having roller cutters according to the invention as well as saddles.

Fig. 2A shows a roller cutter according to the present invention as well as a saddle in side view included in the reamer bit in Fig. 1. Fig. 2B shows a first end

view of the roller cutter according to the present invention and the saddle. Fig. 2C shows schematically a second end view of the roller cutter and the saddle opposite the end view in Fig. 2B.

Fig. 3A shows the roller cutter according to the present invention in a partial cross-section. Fig. 3B shows an enlarged section according to Fig. 3A. Fig. 3C shows a part included in the roller cutter, in perspective view.

Detailed description of the invention

In Fig. 1 is shown how a pilot hole 11, which in a known way is pre-drilled between an upper and a lower, not shown, level in a mine is reamed by means of a drill head designated 10. The drill head 10 is connected to a drive stem 12 by means of which the drill head is rotated and is pressed against a ring-shaped surface 13 that surrounds the pilot hole 11. The surface 13, thus, defines the face of the earth formation.

The invention relates to earth boring in general, but is primarily intended for raise boring. At raise boring, a distance is drilled between the lower and the upper level in a mine, and then the pilot hole is reamed by means of a drill head having a large diameter.

The drill head 10 comprises a body 16 and a plurality of rollers or cutters 14, which are rotatably mounted on the body in fasteners or saddles 15. Each roller cutter comprises circumferential rows of buttons or crushing members of cemented carbide in a known way. The saddles 15 are mounted on the body 16. The drive stem 12 is connected to the body 16.

The body 16 has a mounting surface 17 on which the saddles 15 are carried. The saddle 15 comprises a bottom surface 18 (Fig. 2A), which is intended to be connected, for instance by screwing or welding, to the mounting surface 17. Furthermore, the saddle 15 comprises two legs 19, 20, between which the roller cutter 14 is mounted. The legs 19, 20 are, at the end thereof facing from the bottom surface 18 formed with arms 21, 22. The arms 21, 22 have different lengths from the bottom surface 18, i.e. the arm 22 which leads in the direction of rotation RB of the drill head, see Fig. 2B, is longer than the trailing

arm 21. The arms 21, 22 flank a cavity and each cavity has a concavely curved support surface 23, which is at least partly circular or cylindrical. A normal of the support surface substantially perpendicular to the bottom surface 18 intersects the rotational axis or centre line CL of the roller cutter 14. The support surface 23 connects forwardly in the direction of rotation RC of the roller cutter 14 via a fillet to a shoulder or a collar 25. The shoulder 25 protrudes inside of an imaginary circle, touches or entirely or partly coincides with the support surface 23. The shoulder 25 comprises a stop surface, which is in substantially parallel with a plane that intersects the rotational axis of the roller cutter. The support surface connects further to a chamfer, which substantially follows a tangent to the support surface 23 at the end arranged substantially diametrically opposite the fillet or the shoulder. The chamfer widens the space around the support surface 23 and is intended to facilitate entering of the shaft spigot of the roller cutter 14 in the saddle. A first through-going hole is arranged in each leg, which in the embodiment illustrated mouths in the support surface 23 on the same side of the normal as the shoulder 25 has been arranged. The hole is arranged in the centre area of the support surface as seen in the axial direction of the roller cutter. The centre line of the hole does not intersect centre line CL of the hub 24 but has an extension under the same at a perpendicular distance from the centre line of the roller cutter. Fastening devices in the form of threaded bolts 43 and nuts 44 are intended to hold the roller cutter and the saddle together.

The roller cutter 14 comprises a hardened shaft 33, the ends of which each has a shaft spigot 34 and 35, each one of which has a substantially cylindrical or convex support surface 36, which is intended to abut against the support surface 23 in the saddle. The support surface 36 has an extension approximately 180° in the circumferential direction. The shaft spigot 34, 35 is formed with a second through-going hole, which intersects a planar surface as well as the convexly curved support surface 36. The support surface 36 connects forwards in the direction of rotation RC of the roller cutter 14 to a recess. The recess forms an inwardly opening shoulder 40 and a cylindrical, convex free surface. The free surface is intended to form a space for the shoulder 25 so that the shaft should

be able to be rotated about 45° in the saddle. The planar surface is intended to constitute abutment for the head of a bolt at assembly.

The shaft 33 preferably has an internally hollow space intended to form a gap for feeding of balls to ball bearings and to accept on one hand a lubricating device and on the other hand a protective plug, as is disclosed in US-A-5,984,024, which hereby is incorporated in the present description.

The shaft 33 according to Fig. 3A has a longitudinal centre line CL. A hub 24 is rotatably mounted on the shaft 33 via bearing member 26 and 27, respectively. The bearing member 26 is received in a first groove in the shaft 33, which groove is tangential and extends circumferentially, while the bearing member 27 is received in a second groove in the hub 24, which groove is tangential and extends circumferentially. The hub 24 is locked axially in relation to the shaft 33 by means of lock member 28, preferably in the form of balls, which co-operate with third and fourth grooves in both the shaft 33 and the hub 24, which grooves are tangential and extends circumferentially.

The roller cutter 14 is rotatable relative to sealing support members or covers 29 located at the axial ends of the hub 24. The cover 29 shall protect sealing members 30, which prevent grease from leaking out from the interior of the roller cutter 14. The sealing members are mounted between the hub 24 and the shaft 33 in order to prevent that grease leaks out therebetween. The sealing member 30 is schematically shown in the figures and comprises an advanced seal comprising spring steel and rubber, half of the member being connected to the shaft 33 and the other half being connected to the hub 24. The sealing member 30 is applied between a flange, in which a grease duct or evacuation hole (see dashed lines in Fig. 3B) terminates, and the cover. The covers 29 are also arranged to counteract penetration of drill dust into the bearings. Both covers 29 are circle ring-shaped and has a thickness T. The cover 29 may have an axially directed perpheral flange, possibly passing the radially outer portion of the associated sealing member 30.Each cover 29 comprises two recesses 31, which are arranged diametrically opposite to each other. Each recess 31 comprisesa rectangular groove, which has an extension from a radially inner

bordering surface 62, corresponding to the inner diameter of the circle ring, and radially outwardly. The groove is not through-going in the thickness direction of the cover but an axial inner wall 32 has been saved as anvil. The wall 32 is substantially perpendicular to the thickness direction of the cover.

The shaft 33 has an indentation arranged or a groove 50 arranged in the envelope surface 51 of the shaft, which is best seen in Figs. 3B and 3C. The groove 50 is substantially V-shaped and comprises a surface 52 angled in the axial direction. The groove 50 is arranged radially outside of the shaft spigot 34, 35. The surface 52 slopes downwardly and inwardly in the direction towards the opposite shaft spigot 34. An imaginary extension line L of the surface 52 intersects the centre line CL in or near the opposite shaft spigot 34. The groove 50 has substantially the same width in the lateral direction of the shaft as the width of the recess 31 or somewhat greater.

A pin 60 of some well weldable steel material is intended to be inserted into the recess 31 and the groove 50 when the cover 29 has been placed around the shaft 33. The pin 60 is solid and has a right cylindrical basic shape. The pin 60 is also denominated projection. The opening, which is formed between the recess 31 and the surface 52, is substantially equally large as the diameter of the pin or somewhat larger. The pin is inserted through said opening and will then support, by means of linear abutment against the surface 52 of the shaft and against the axially inner wall 32 of the cover. Then, a weld 61 is laid between the pin and the recess 31 in order to secure the axial position of the pin in relation to the cover. The pin 60 will then project radially inside the radially inner bordering surface 62 of the cover. Alternatively, the pin may instead of by means of welding be locked by means of some mechanical fastening member, e.g., a screw.

The corresponding procedure is carried out at the other opposite recess on the cover as well as at the recesses of the second cover. If there is a gap between the pin 60 and the surface 52 after the welding, the cover will be able to be moved a limited distance in the axial direction before contact arises between the pin 60 and the surface 52, whereby the cover is being prevented from falling down on the shaft spigot 35.

At use of the drill head, frictional forces will want to rotate the covers. However, the pins 60 lock the covers against rotation in relation to the shaft without any weld affecting the strength of the hardened shaft being difficult to weld. Thus, the cover 29 comprises a radially directed projection 60, which is arranged to be received in an indentation 50 in the envelope surface of the shaft 33 in order to lock the cover axially in relation to the shaft. Furthermore, the cover is also locked in the tangential direction, i.e. the cover is rotationally secured, by means of co-operation between the projection 60 and the indentation 50.

Thus, the present invention relates to a roller cutter for rotary boring of the front of earth and rock formations, the designs of which contribute to longer operating periods by means of more durable roller cutters, the shaft of which does not crack as easy at load and the cover of which is simple to fix.